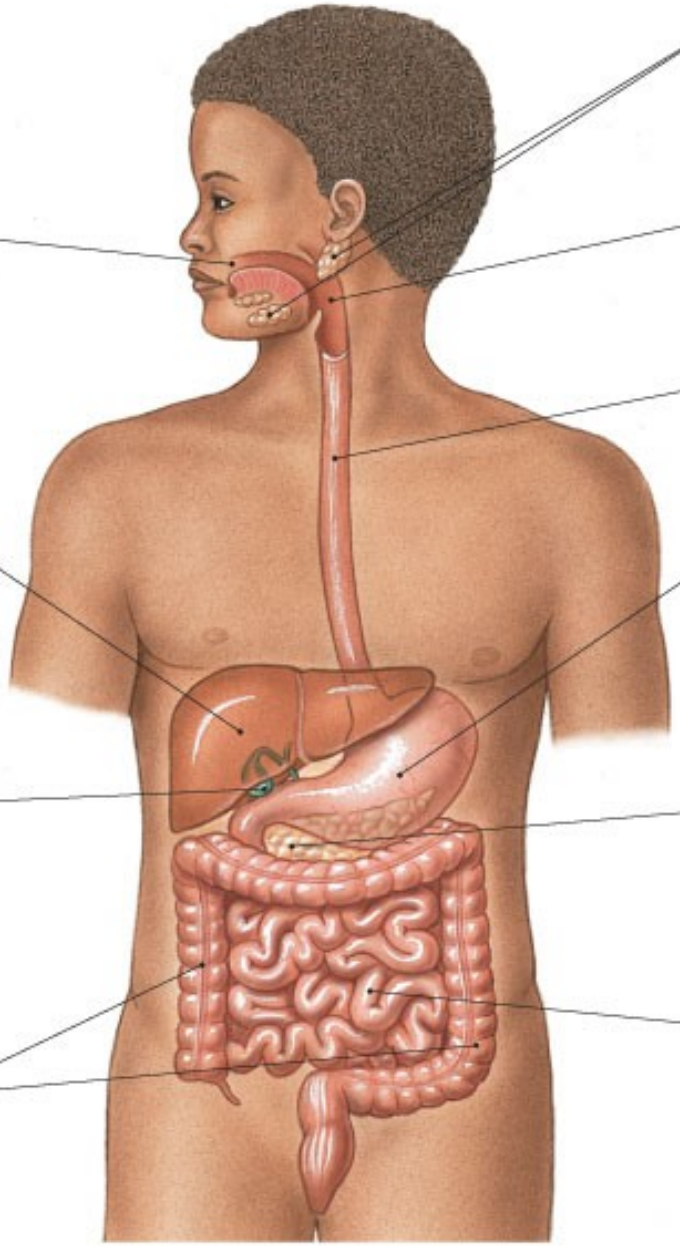
The Digestive System



ORAL CAVITY, TEETH, TONGUE

Mechanical processing, moistening, mixing with salivary secretions

LIVER

Secretion of bile (important for lipid digestion), storage of nutrients, many other vital functions

GALLBLADDER

Storage and concentration of bile

LARGE INTESTINE

Dehydration and compaction of undigestible materials in preparation for elimination

SALIVARY GLANDS

Secretion of lubricating fluid containing enzymes that break down carbohydrates

PHARYNX

Pharyngeal muscles propel materials into the esophagus

ESOPHAGUS

Transport of materials to the stomach

STOMACH

Chemical breakdown of materials via acid and enzymes; mechanical processing through muscular contractions

PANCREAS

Exocrine cells secrete buffers and digestive enzymes; endocrine cells secrete hormones

SMALL INTESTINE

Enzymatic digestion and absorption of water, organic substrates, vitamins, and ions

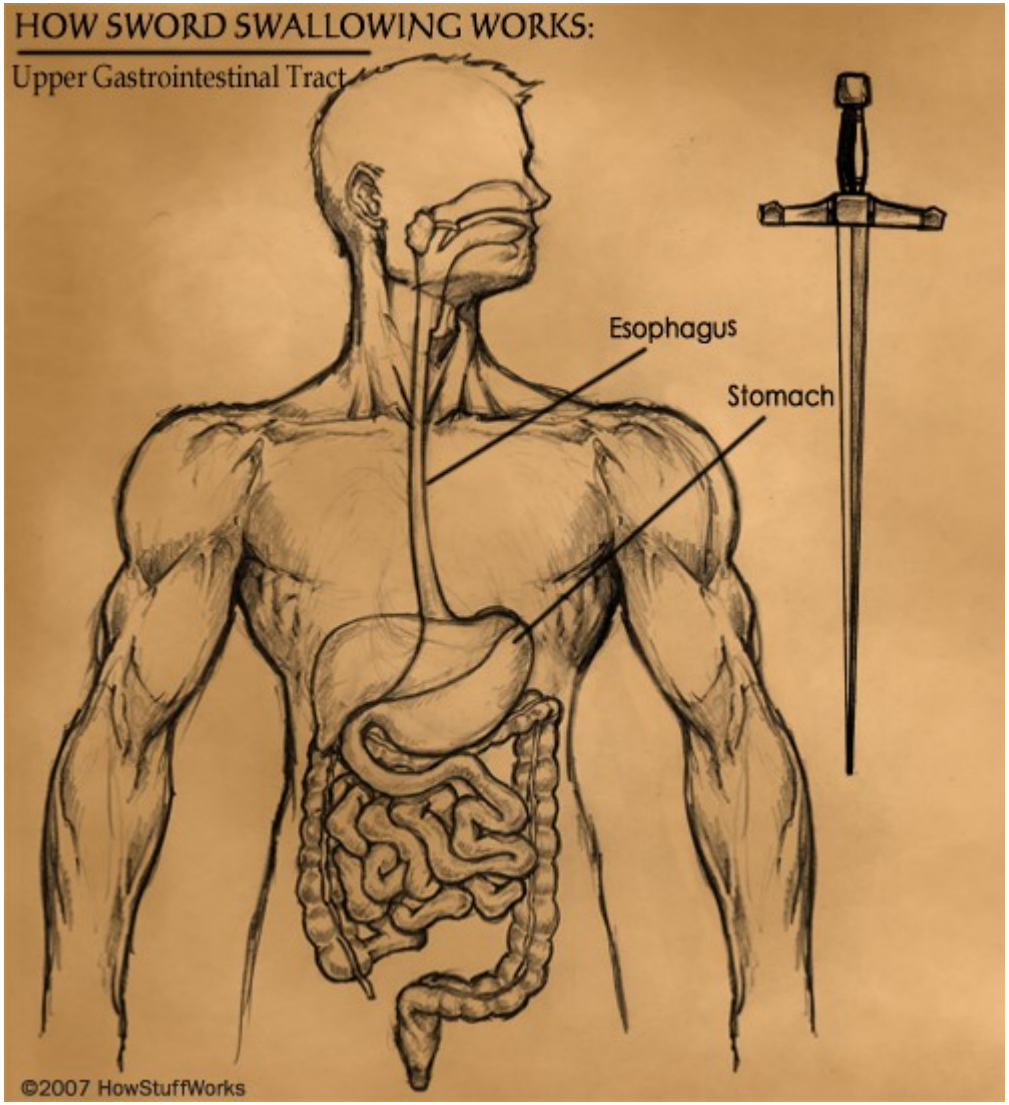
Digestive Processes

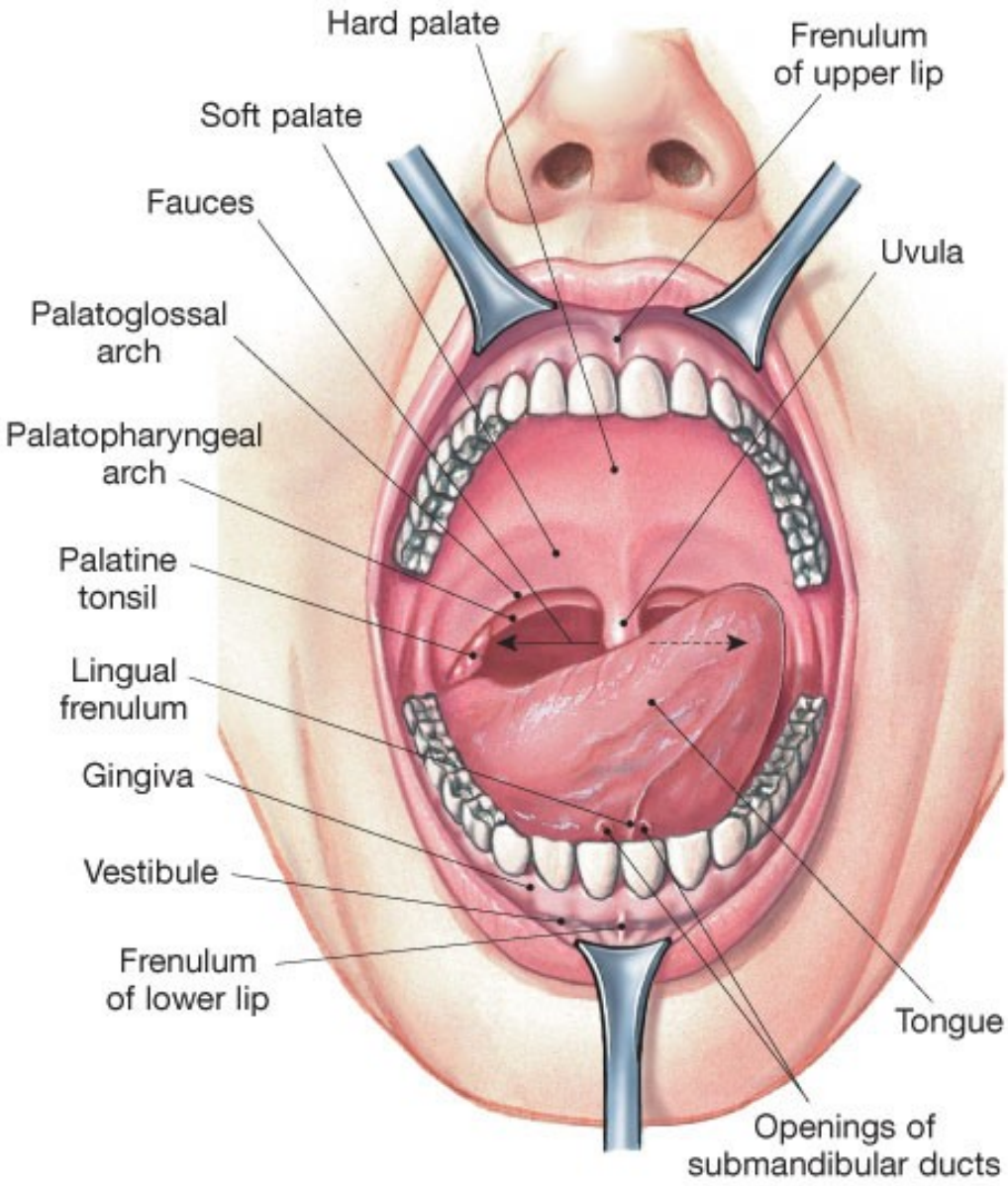
- Ingestion – taking food/drink into mouth.
- Propulsion – movement through alimentary canal (swallowing, peristalsis).
- Mechanical Digestion – *Physical* breakdown of food (chewing, churning).

- Chemical Digestion – *Enzymatic* breakdown of food (from complex to simple building blocks).

- Absorption – transport of digested products from lumen of G.I. tract to blood and lymph (*inside* body).

- Defecation – elimination of indigestable and waste products from body (feces).


HOW SWORD SWALLOWING WORKS:
Upper Gastrointestinal Tract
Esophagus
Stomach
©2007 HowStuffWorks


Hard palate
Frenulum of upper lip
Soft palate
Fauces
Uvula
Palatoglossal arch
Palatopharyngeal arch
Palatine tonsil
Lingual frenulum
Gingiva
Vestibule
Frenulum of lower lip
Tongue
Openings of submandibular ducts

Salivary Glands

Intrinsic (inside oral cavity) e.g., lips & cheeks.

Extrinsic (outside oral cavity):

"Mumps"

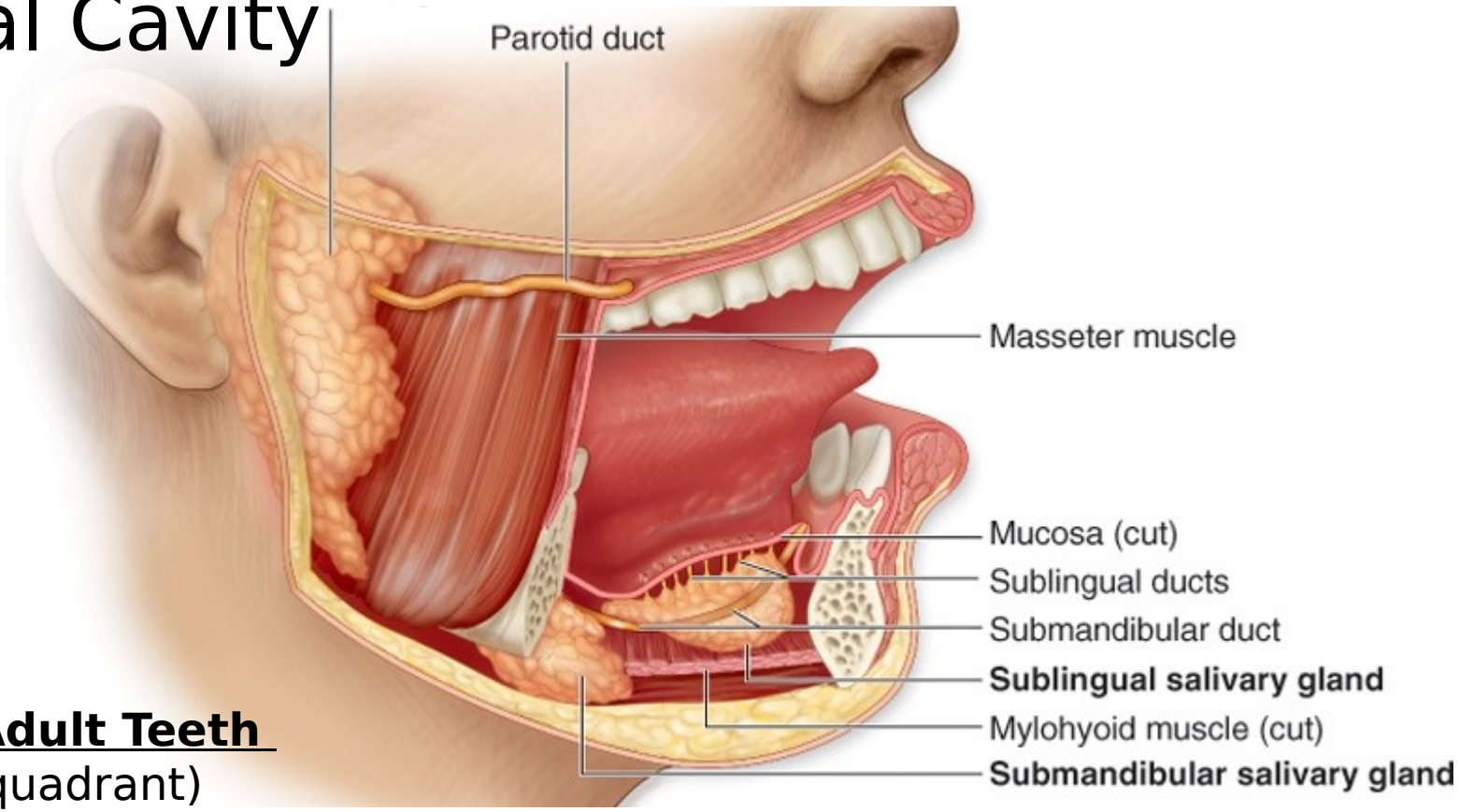
1) Parotid (largest) - a serous gland.

2) Submandibular - a serous gland.

3) Sublingual (smallest) - a mucus gland

- Lingual amylase (breaks down starch).
- Lysozyme – antibacterial agent in saliva.

The Oral Cavity

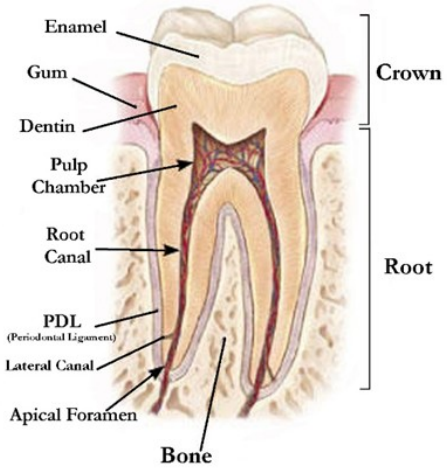


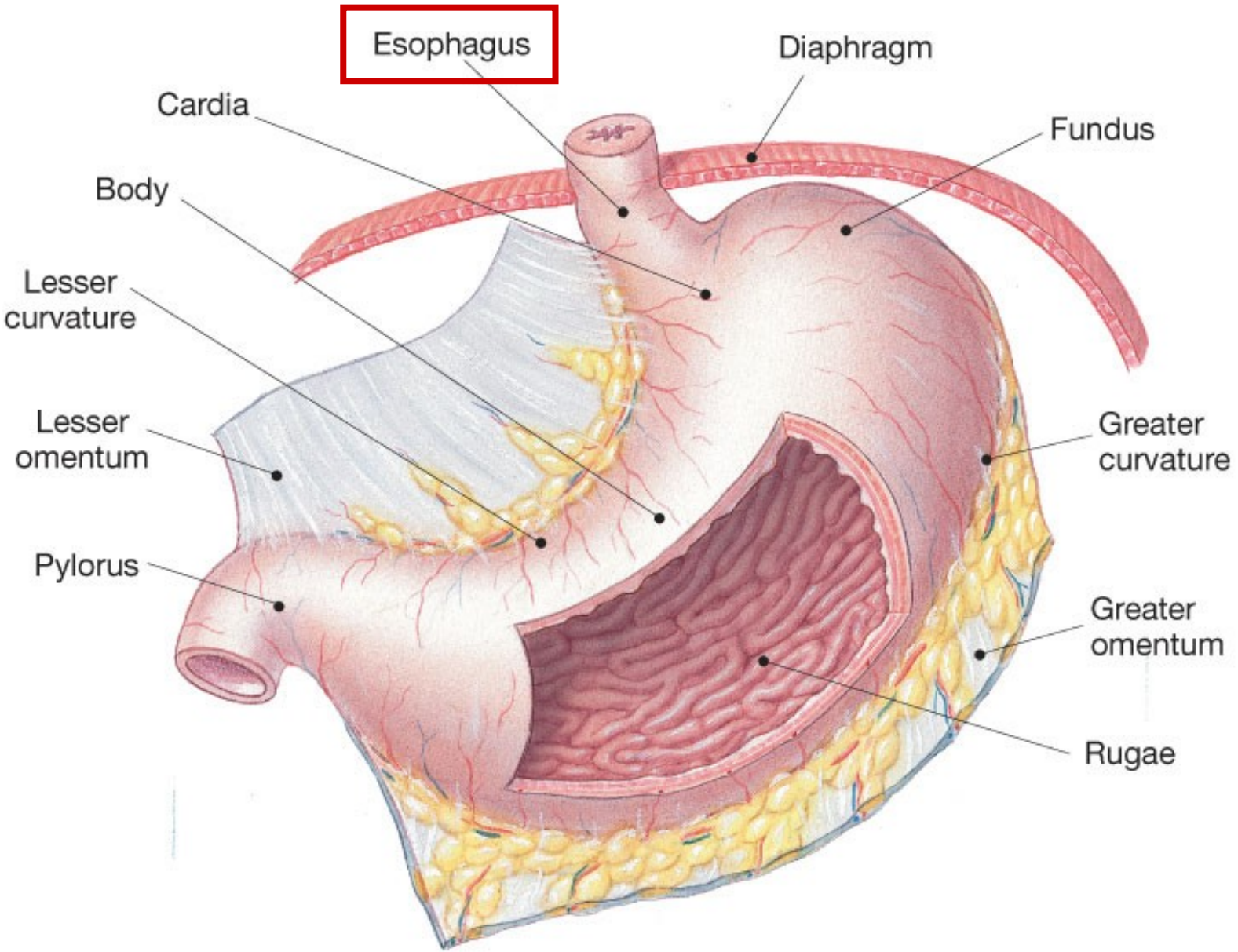
Typical Adult Teeth
(in one quadrant)

Incisors	**2**
Canines	**1**
Premolars	**2**
Molars	**3**
=	**8**

Times 4 quadrants:

Total: 4 x 8 = **32**




Esophagus
Diaphragm
Cardia
Fundus
Body
Lesser curvature
Lesser omentum
Greater curvature
Pylorus
Greater omentum
Rugae

- **The Esophagus -** is a Muscular tube.

– ~ 10 inches long.

– Transitions from skeletal to smooth muscle (hence voluntary to involuntary)

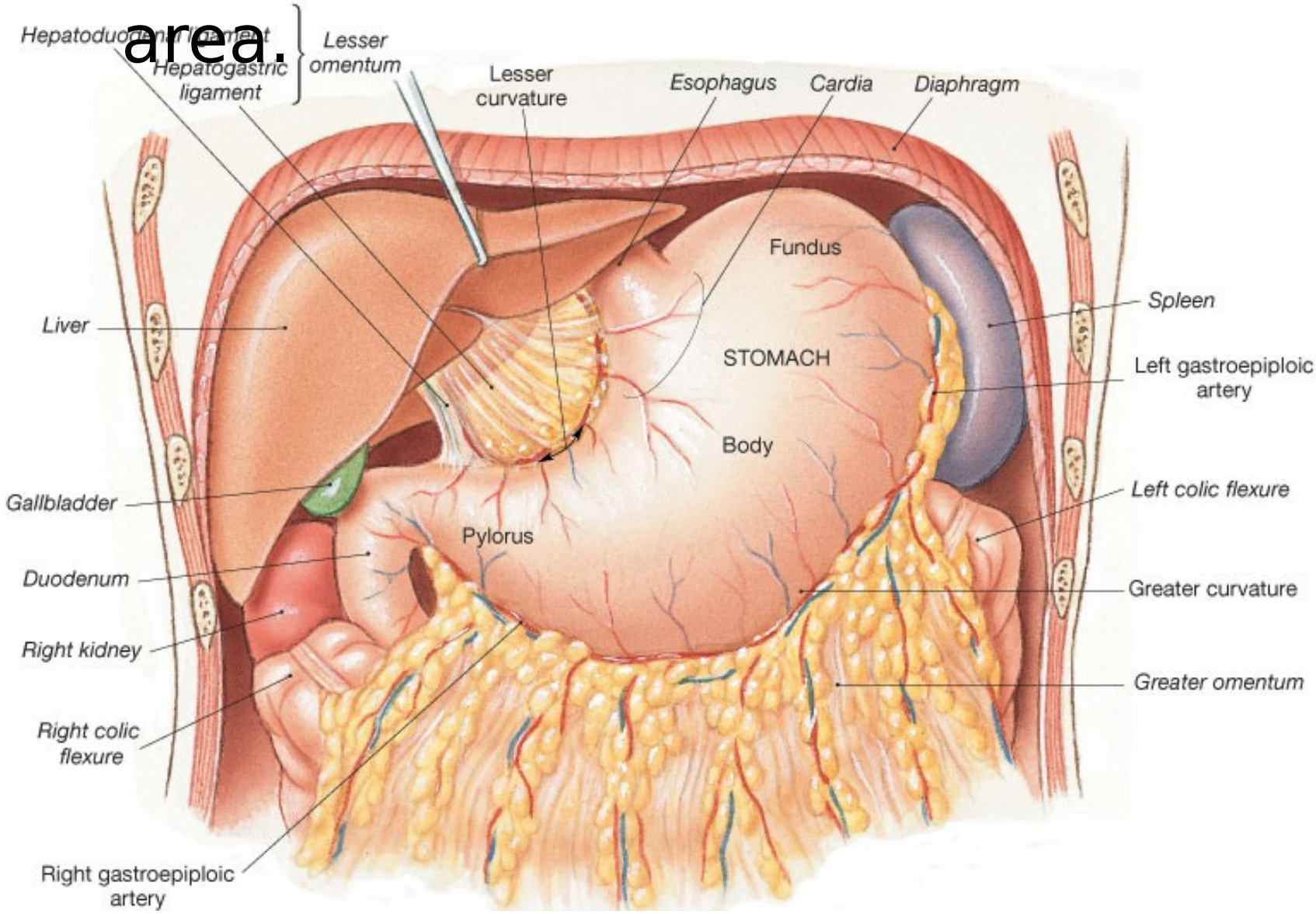
– Mucous glands in tela submucosa (layer) to lubricate bolus.

– Outermost layer is Adventitia or Serosa.

outside peritoneal cavity

inside peritoneal cavity

- **The Stomach -** an acidic storage area.



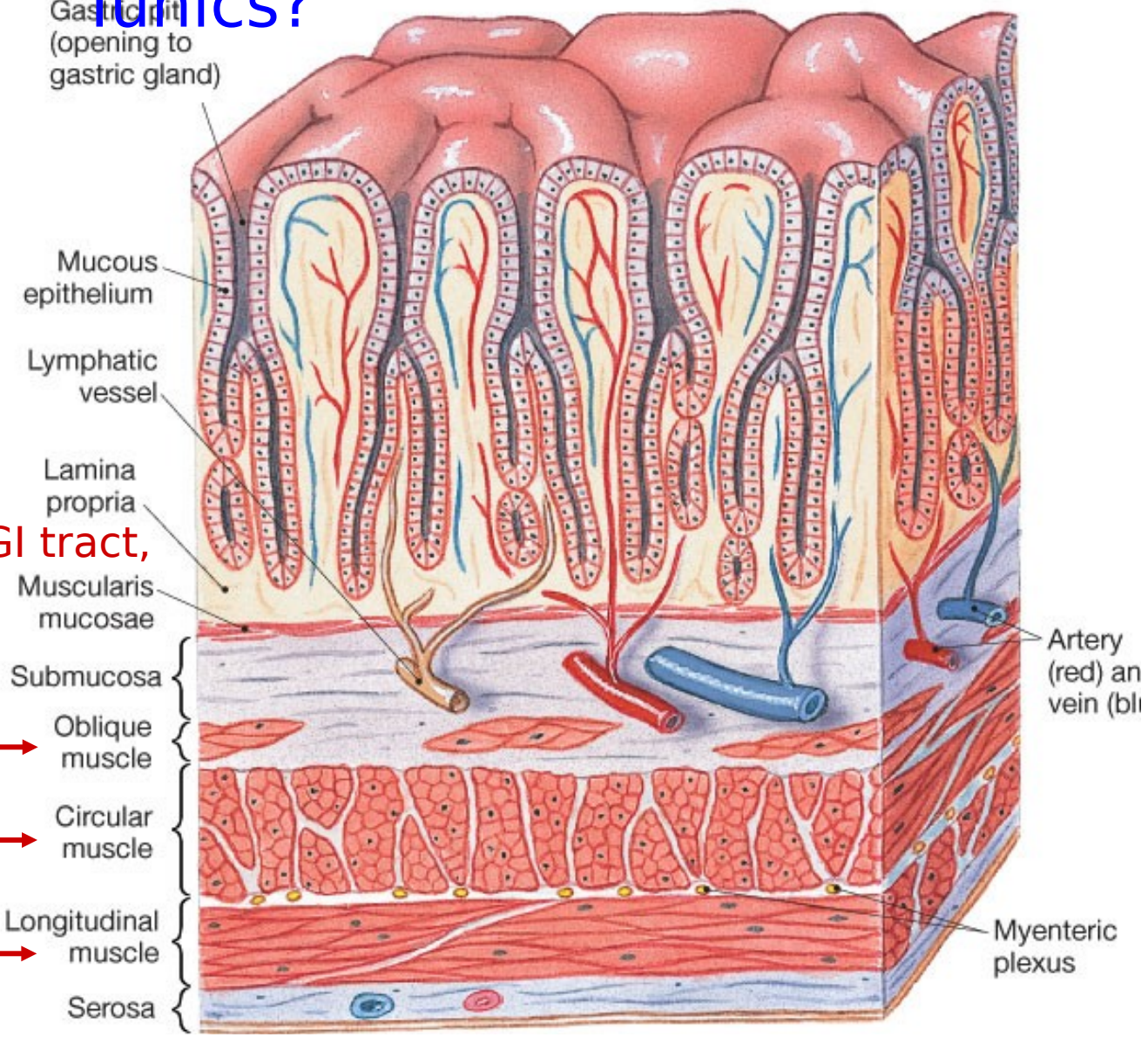
- Stomach – acidic (pH 2) storage of **chyme**.

  Mechanical Digestion continued (churning).

  Has 3 muscle layers, for churning.
- Enzymatic Digestion of proteins occurs here (Pepsin breaks down proteins).
- Only Absorption of alcohol and aspirin.

- Rugae allows for expansion when volume of contents increase.

Can you identify the 4 Tunics?



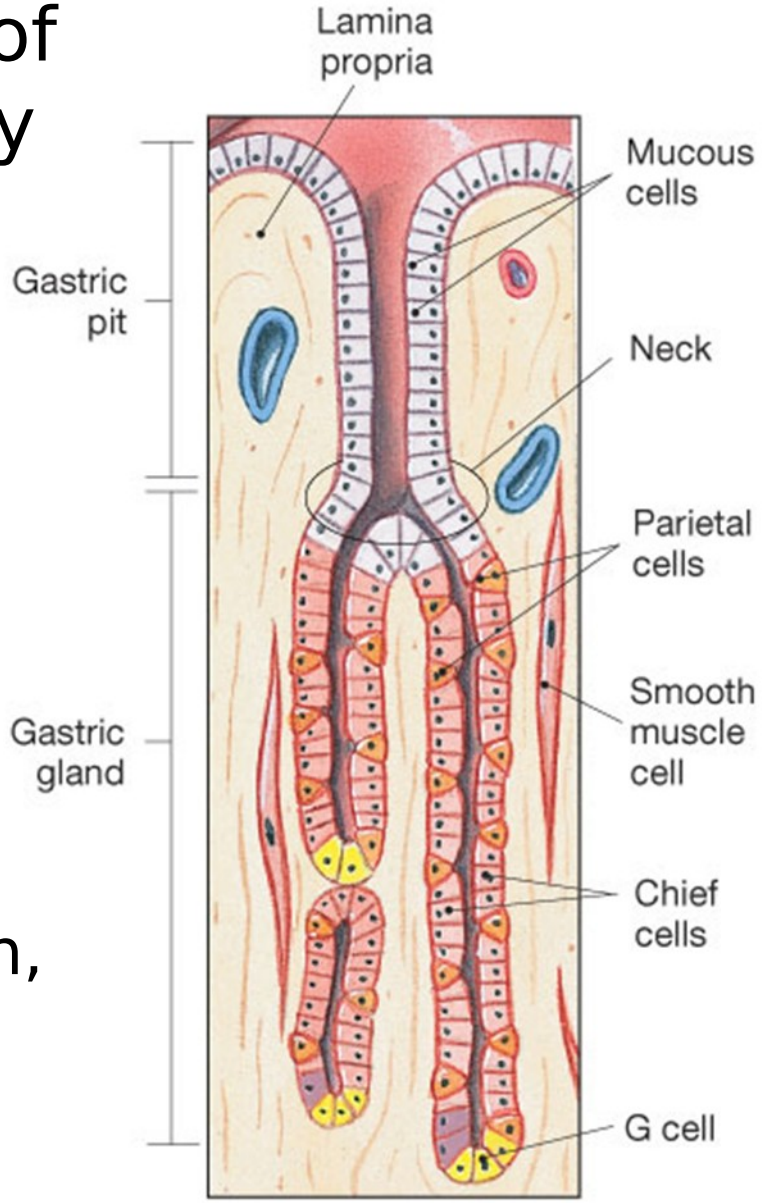
Unique in the GI tract, the stomach has 3 muscle layers:

- ☐ →
- ☐ →
- ☐ →

Production and secretion of gastric juices controlled by CNS. e.g., Vagus nerve

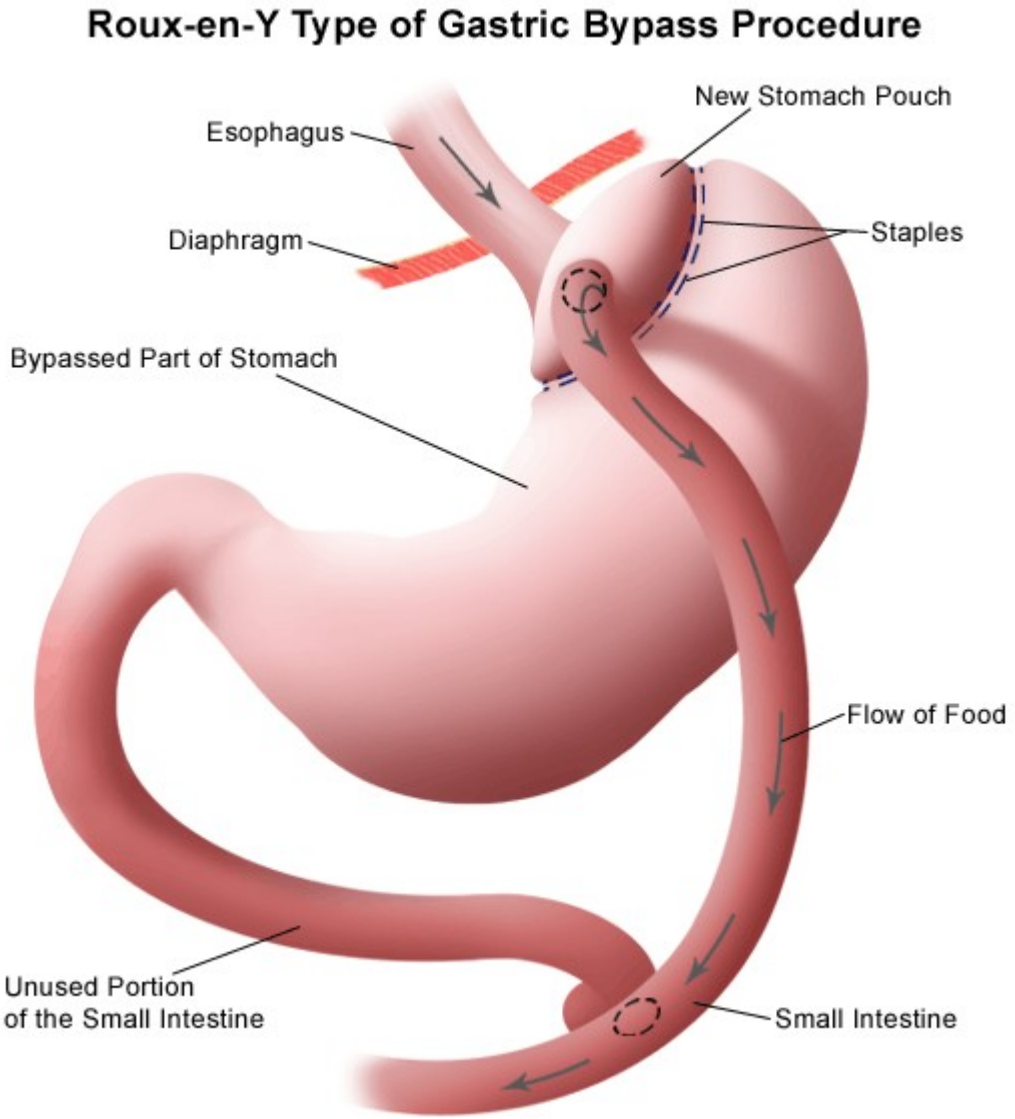
Parietal cells: make Hydrocholic acid (HCl) in gastric glands.

Chief cells: make Pepsinogen, which is cleaved to pepsin (↑HCl), to digest proteins.



Gastric Gland

Gastric Bypass (Malabsorptive) Surgery



nall Intestine: Chemical Digestion/Absorption

Duodenum

Jejunum

Ileum

Increase Surface Area for Absorption

1) Plicae Circulares

2) Villi (Intestinal)

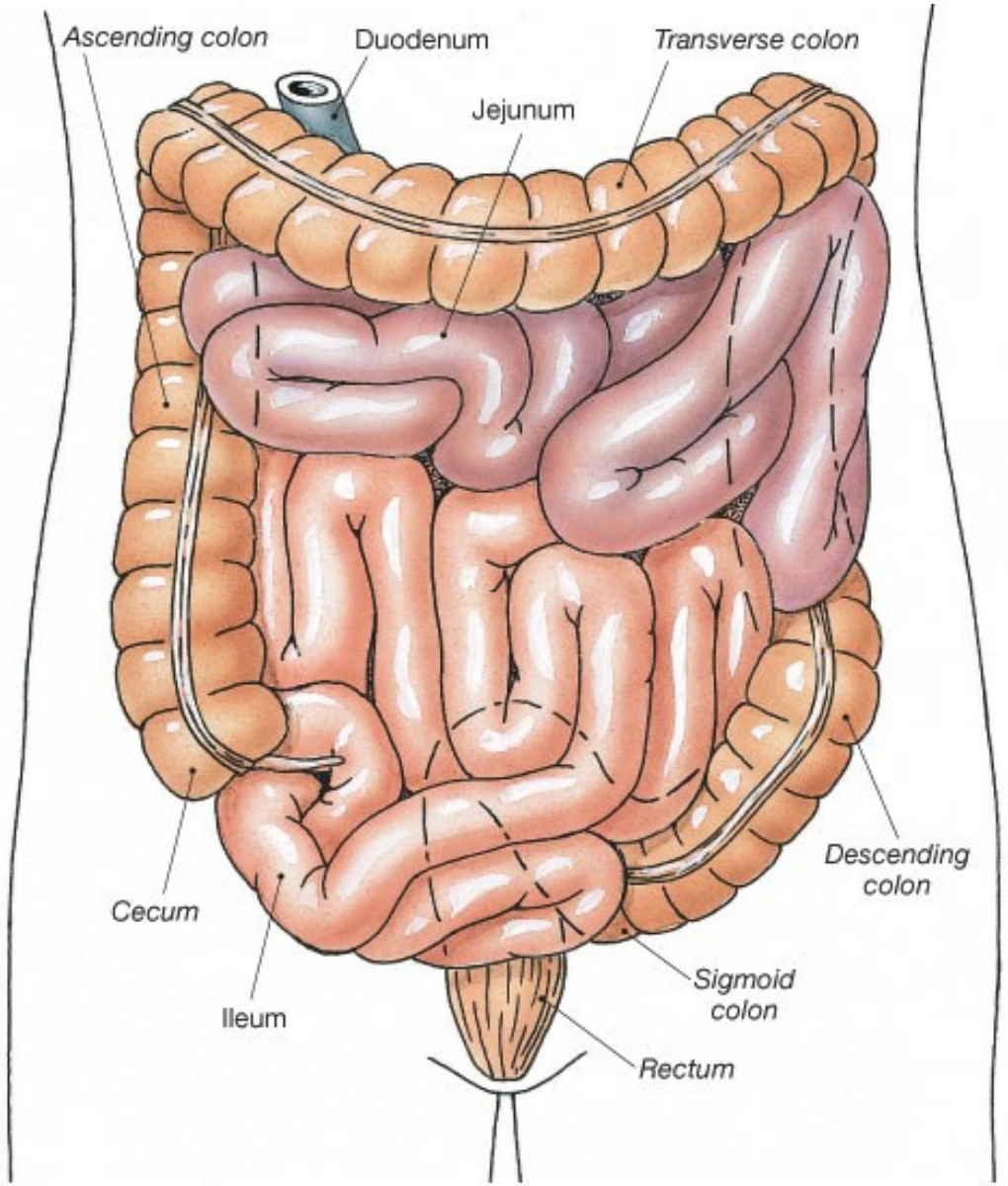
3) Microvilli

Lacteals absorption lipids

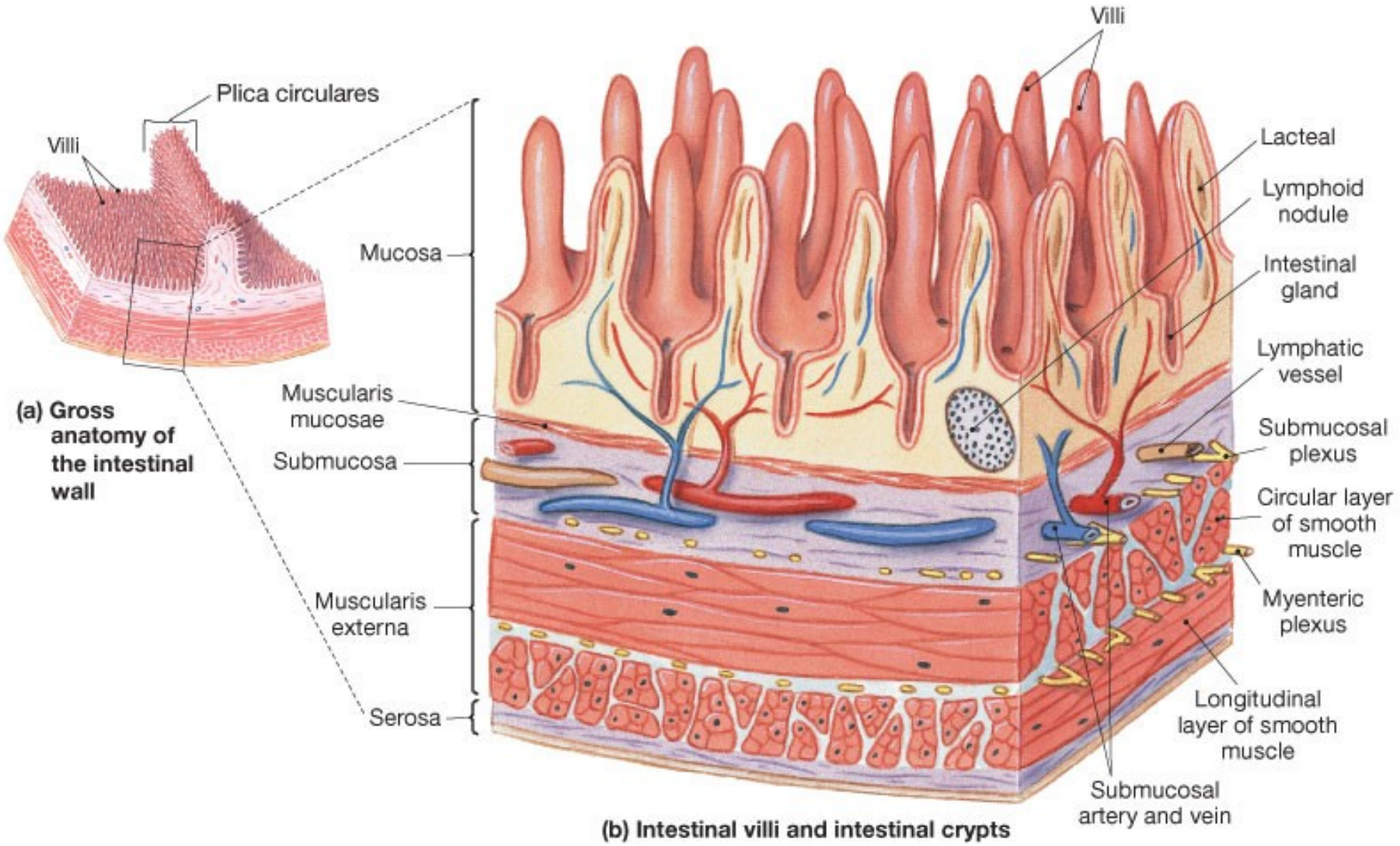
Intestinal glands

Goblet cells

Stem cells



The Small Intestine



Villi of Small Intestine

Vascular Arcade
(from superior mesenteric a.)

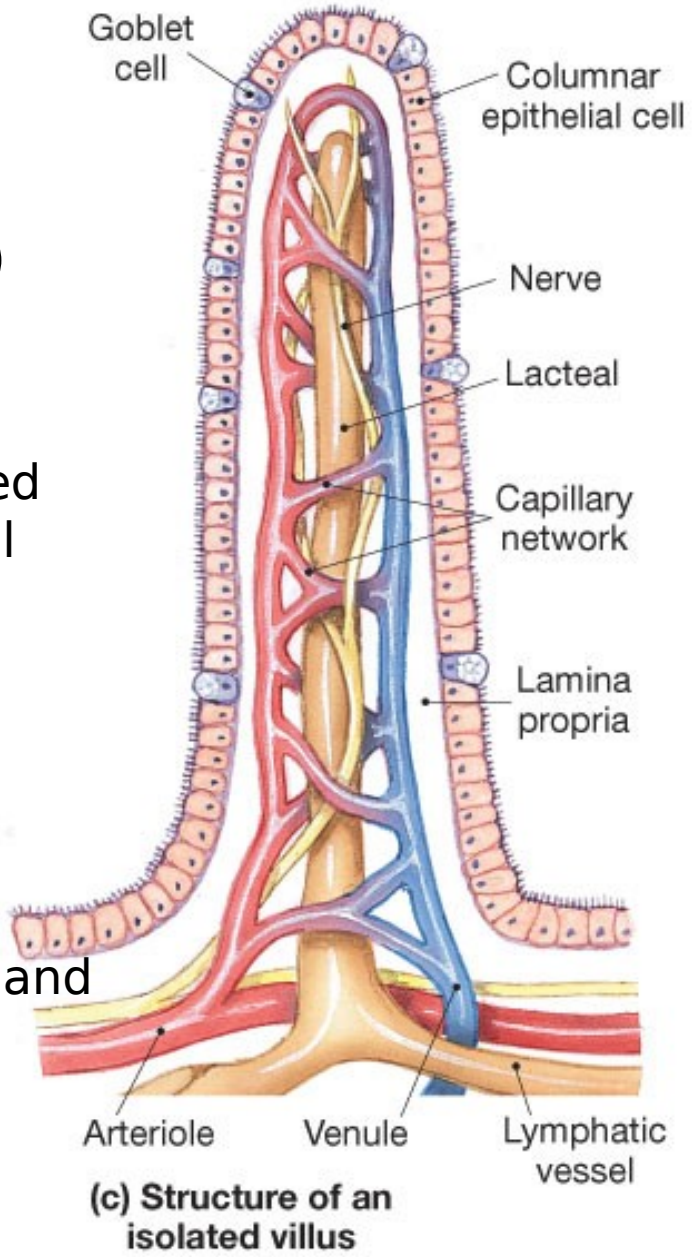
<u>Mesentery Proper</u> - is a double layered serous membrane attached to the small intestine.

Roles:

- Supports branches of blood vessels.

- Supports lymphatics of the jejunum and ileum.

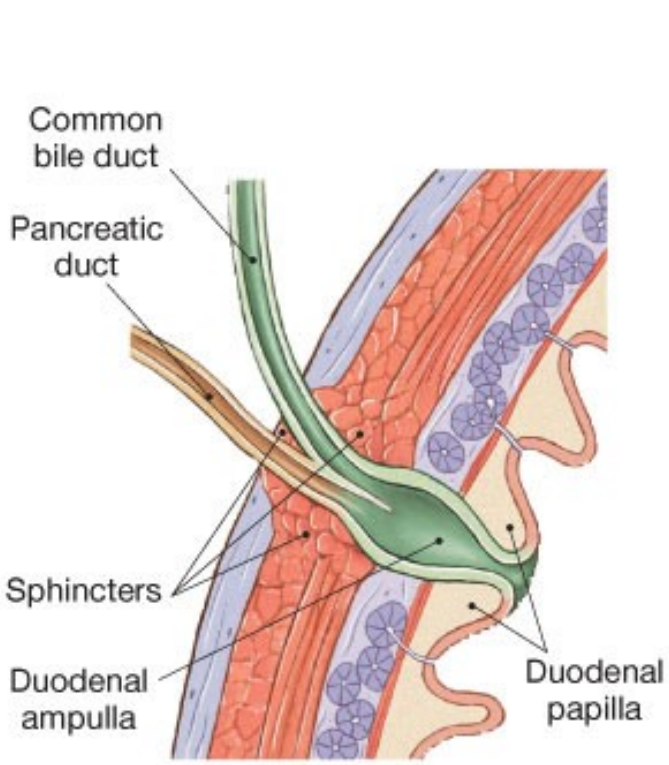
- Supports nerves of the jejunum and ileum.

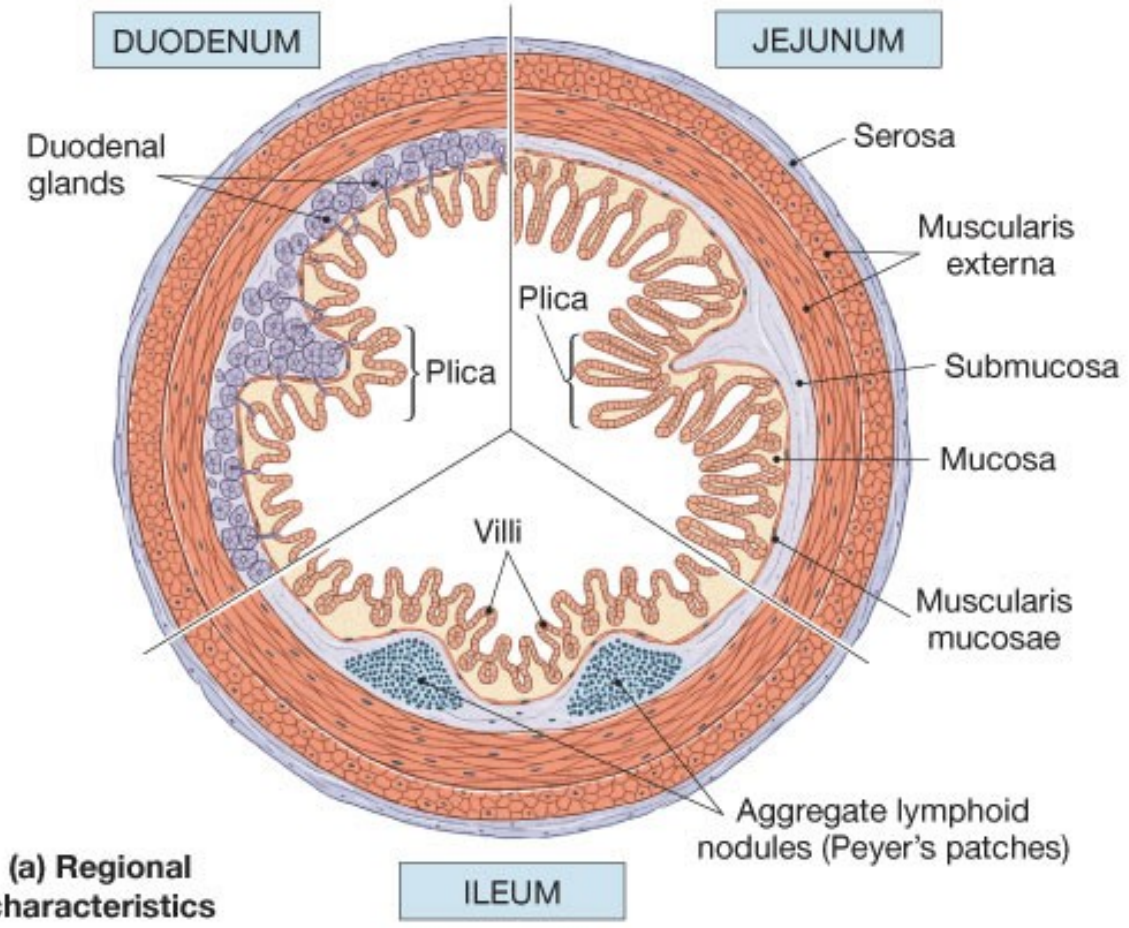


The Mesentery Proper of the Small Intestine

The Greater Omentum

Distinguishing features of each region of the Small Intestine





(a) Regional characteristics

The Large Intestine

Begins as pouch inferior to end of ileum

Ends at anus.

Functions of Large Intestine:

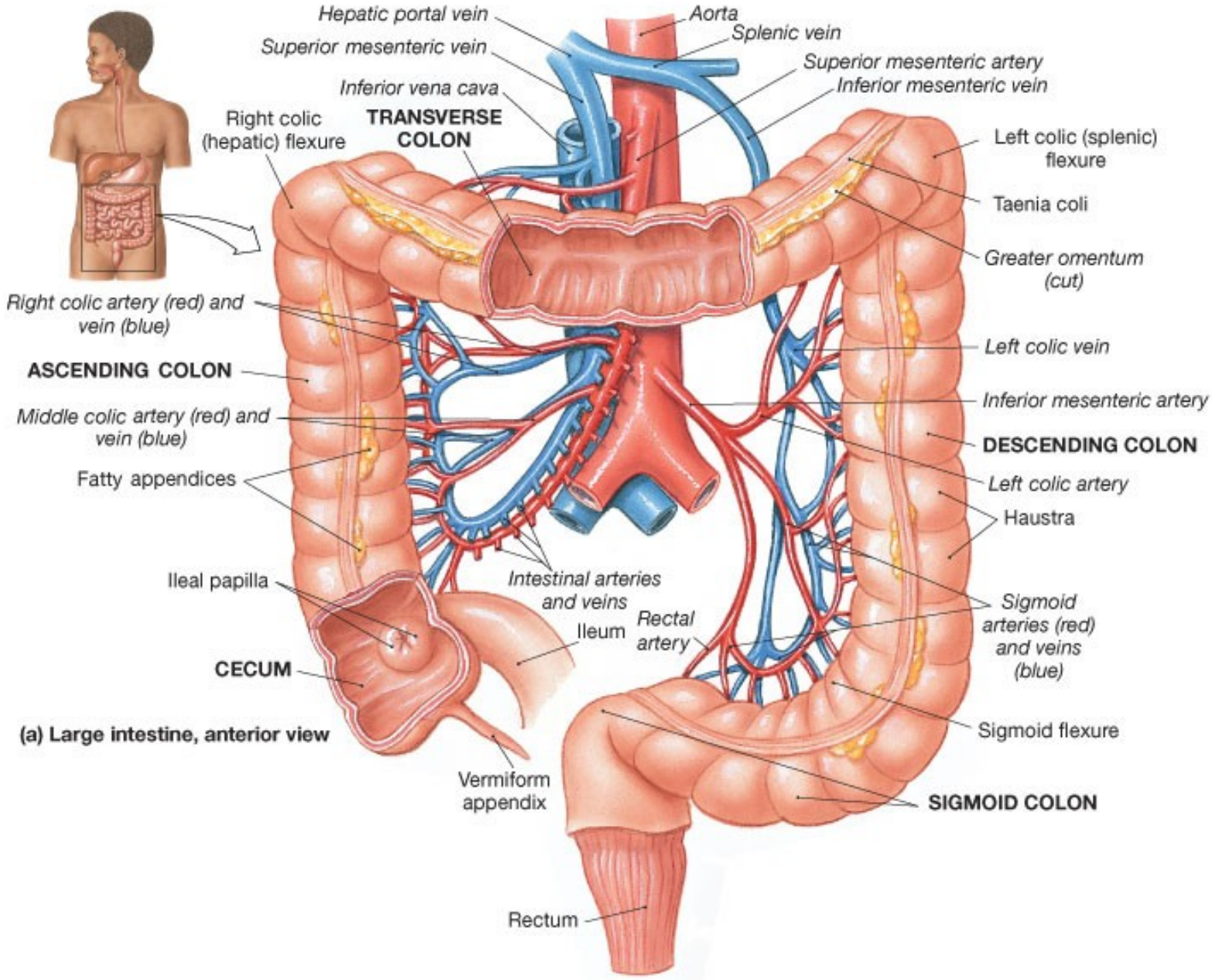
1) Reabsorb water and compact feces.
2) Absorb vitamins (helps make Vit K) electrolytes.
3) Stores fecal matter.

The Cecum:

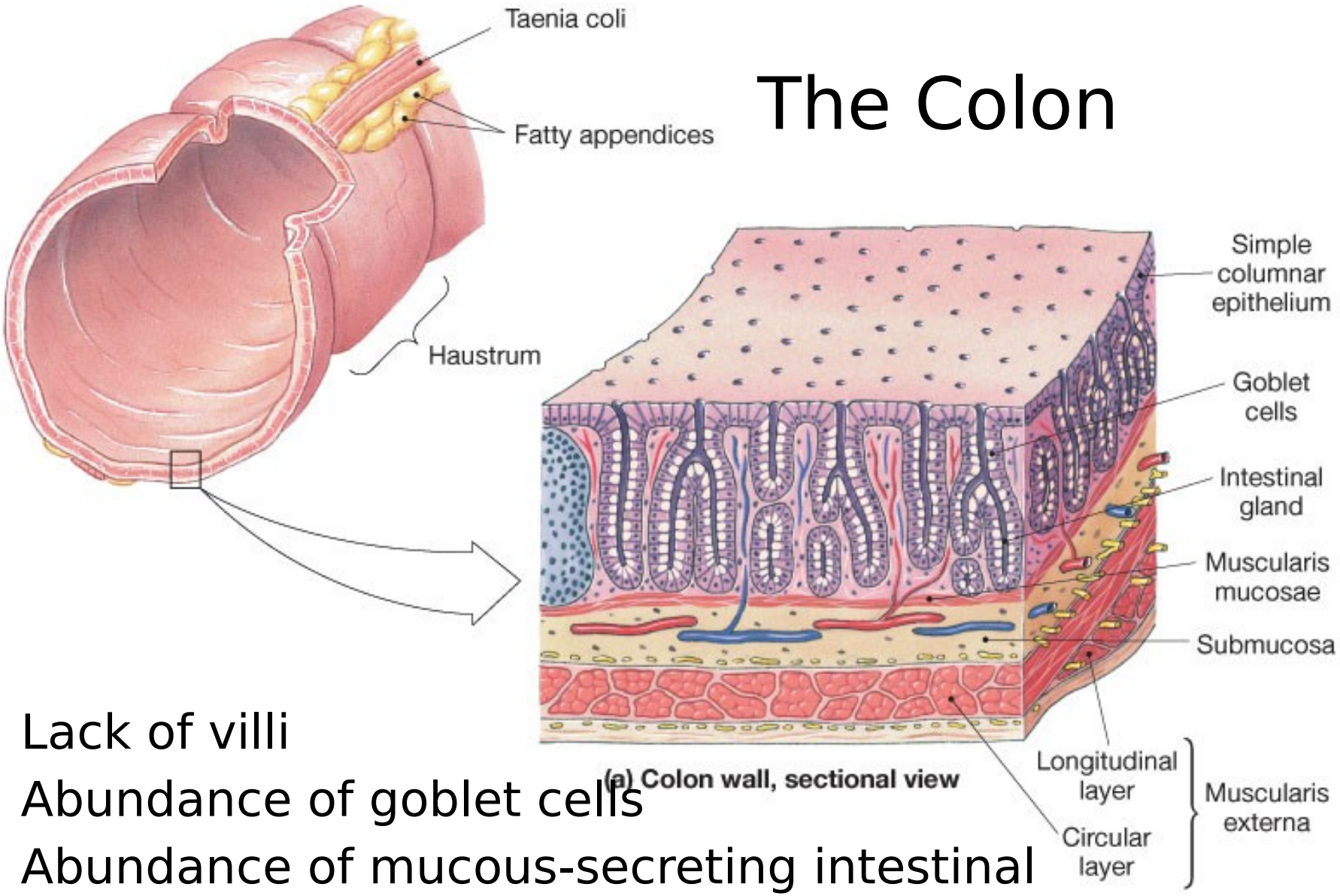
- Contains the Ileocecal valve and connected to appendix.

The Colon:

– Ascending, Transverse, Descending, Sigmoid.

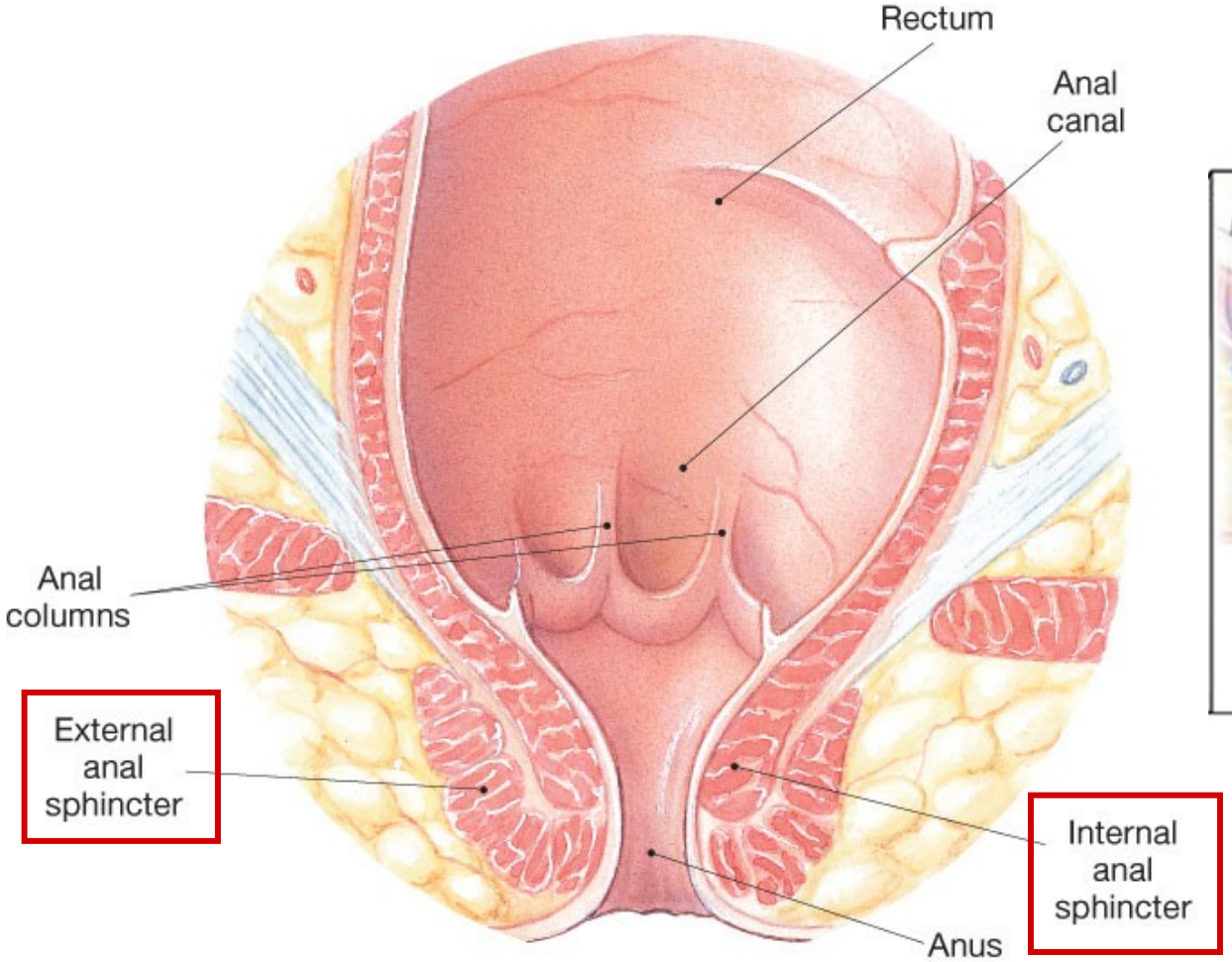

Hepatic portal vein
Aorta
Splenic vein
Superior mesenteric vein
Superior mesenteric artery
Inferior mesenteric vein
Inferior vena cava
Right colic (hepatic) flexure
TRANSVERSE COLON
Left colic (splenic) flexure
Taenia coli
Greater omentum (cut)
Right colic artery (red) and vein (blue)
Left colic vein
ASCENDING COLON
Inferior mesenteric artery
Middle colic artery (red) and vein (blue)
DESCENDING COLON
Fatty appendices
Left colic artery
Haustra
Ileal papilla
Intestinal arteries and veins
Sigmoid arteries (red) and veins (blue)
Ileum
Rectal artery
CECUM
Sigmoid flexure
(a) Large intestine, anterior view
Vermiform appendix
SIGMOID COLON
Rectum

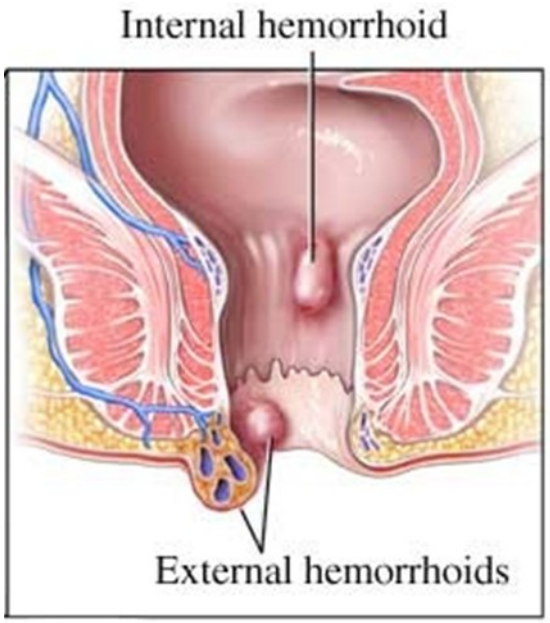
The Colon



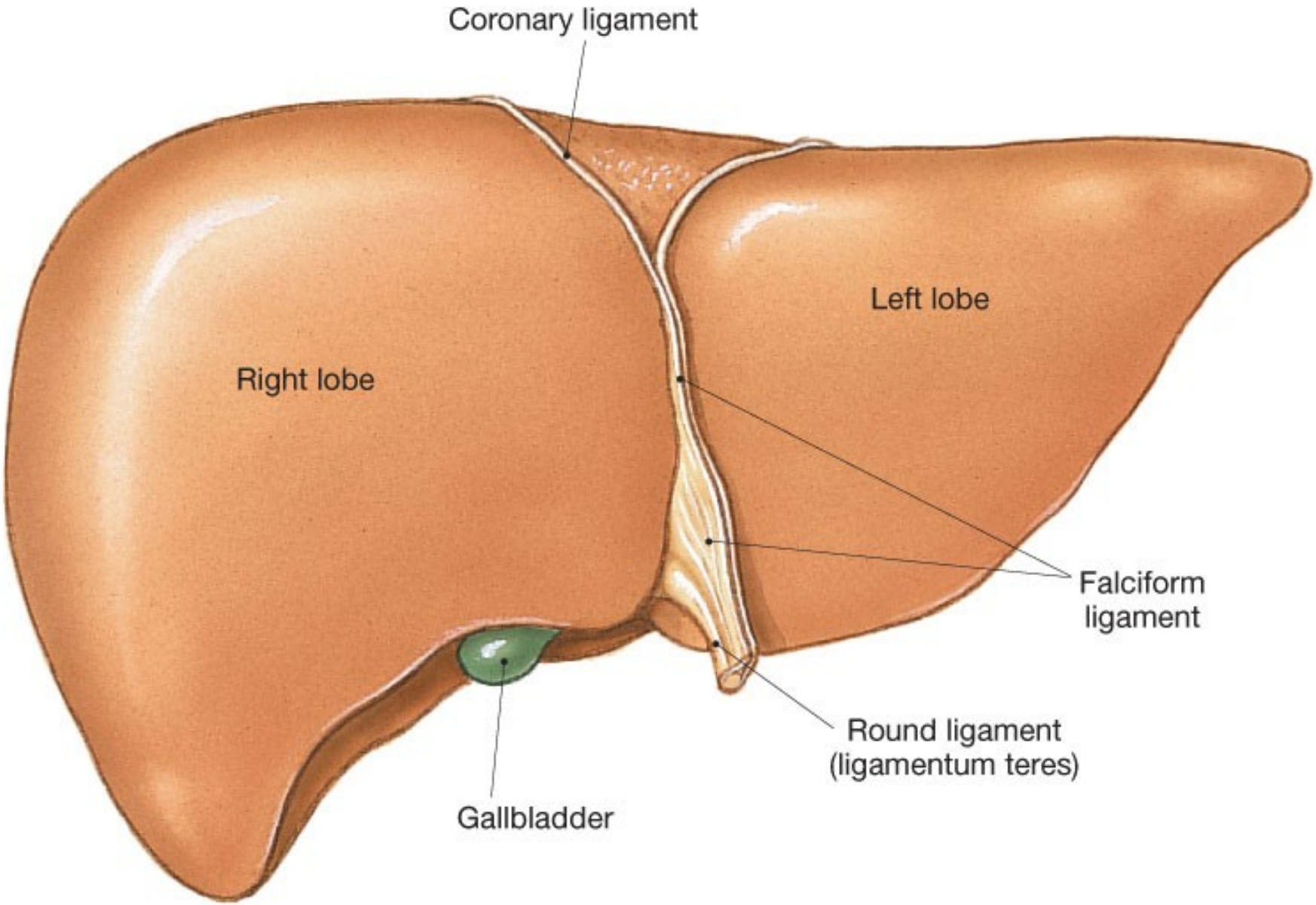
- Lack of villi
- Abundance of goblet cells
- Abundance of mucous-secreting intestinal glands

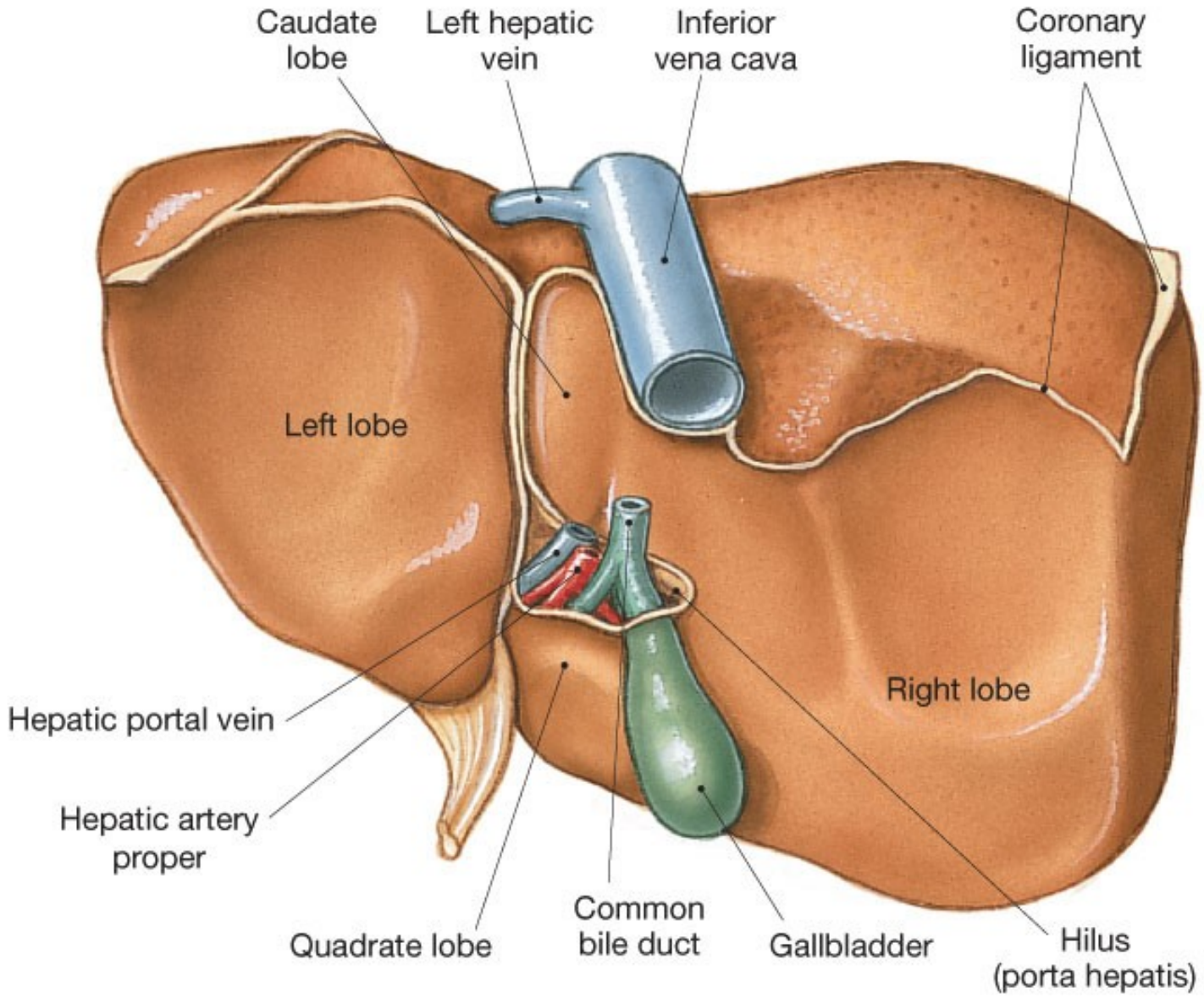
The Rectum and Anus



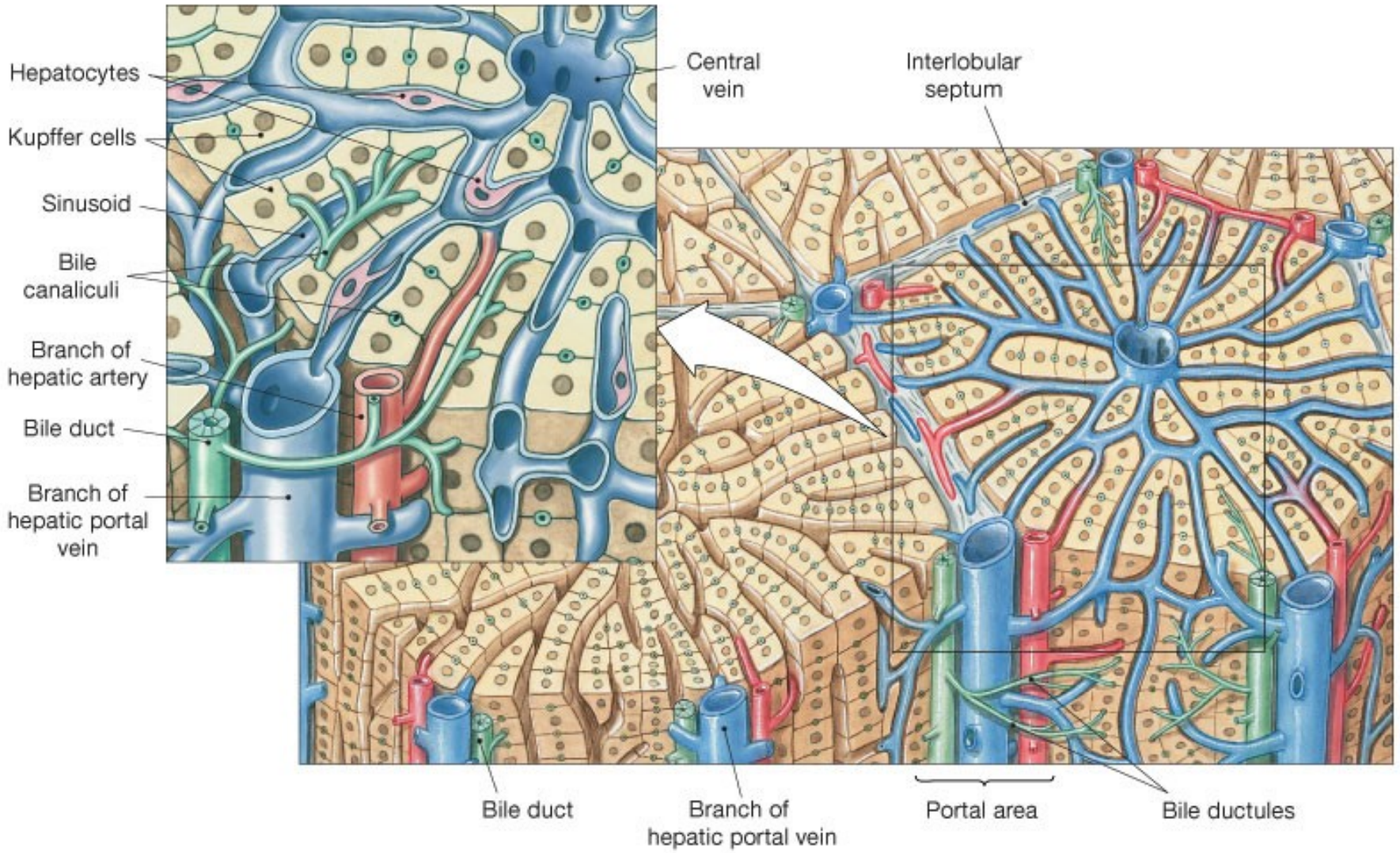


The Liver

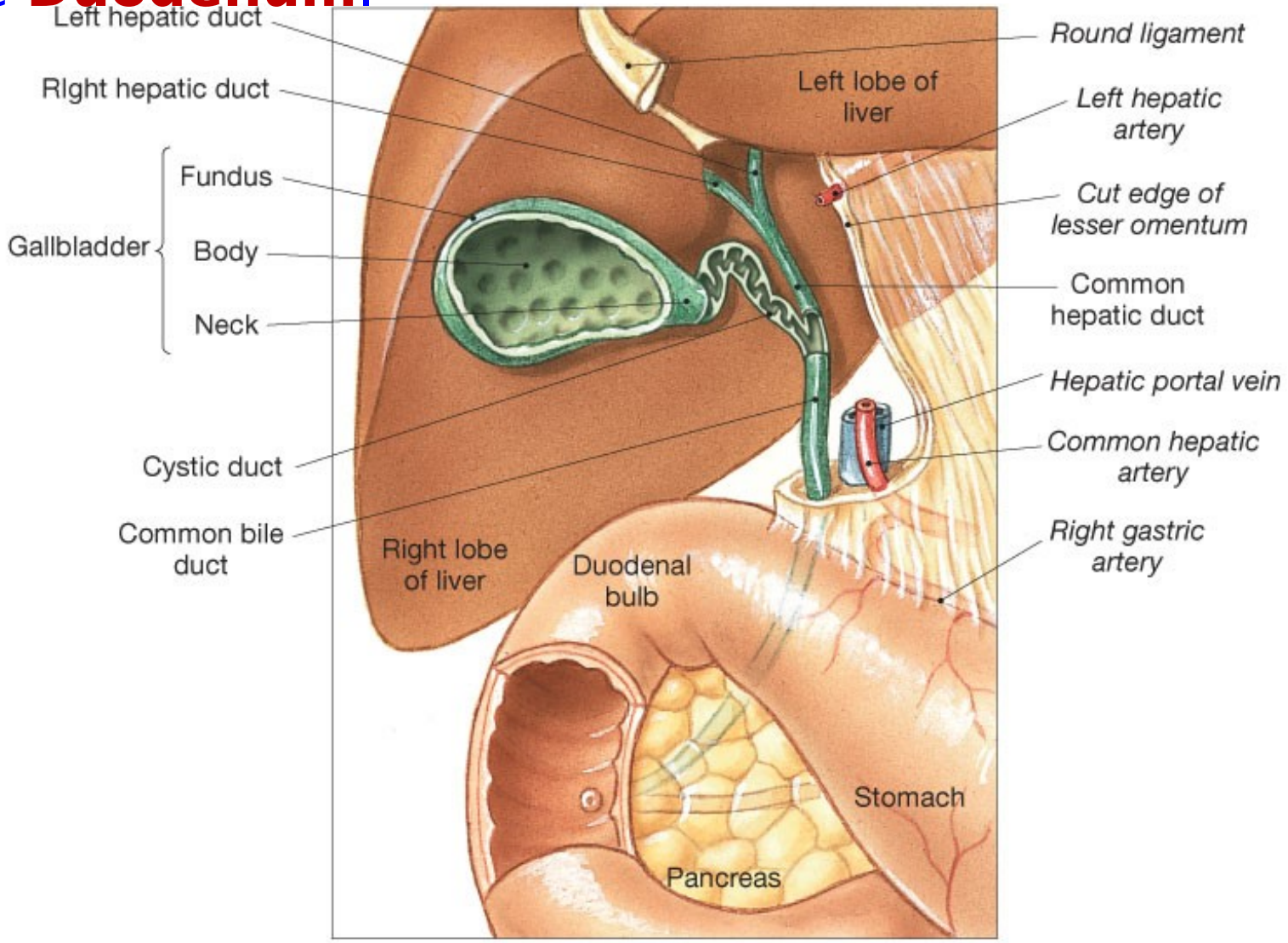

Coronary ligament
Left lobe
Right lobe
Falciform ligament
Round ligament (ligamentum teres)
Gallbladder


Caudate lobe
Left hepatic vein
Inferior vena cava
Coronary ligament
Left lobe
Right lobe
Hepatic portal vein
Hepatic artery proper
Quadrate lobe
Common bile duct
Gallbladder
Hilus (porta hepatis)

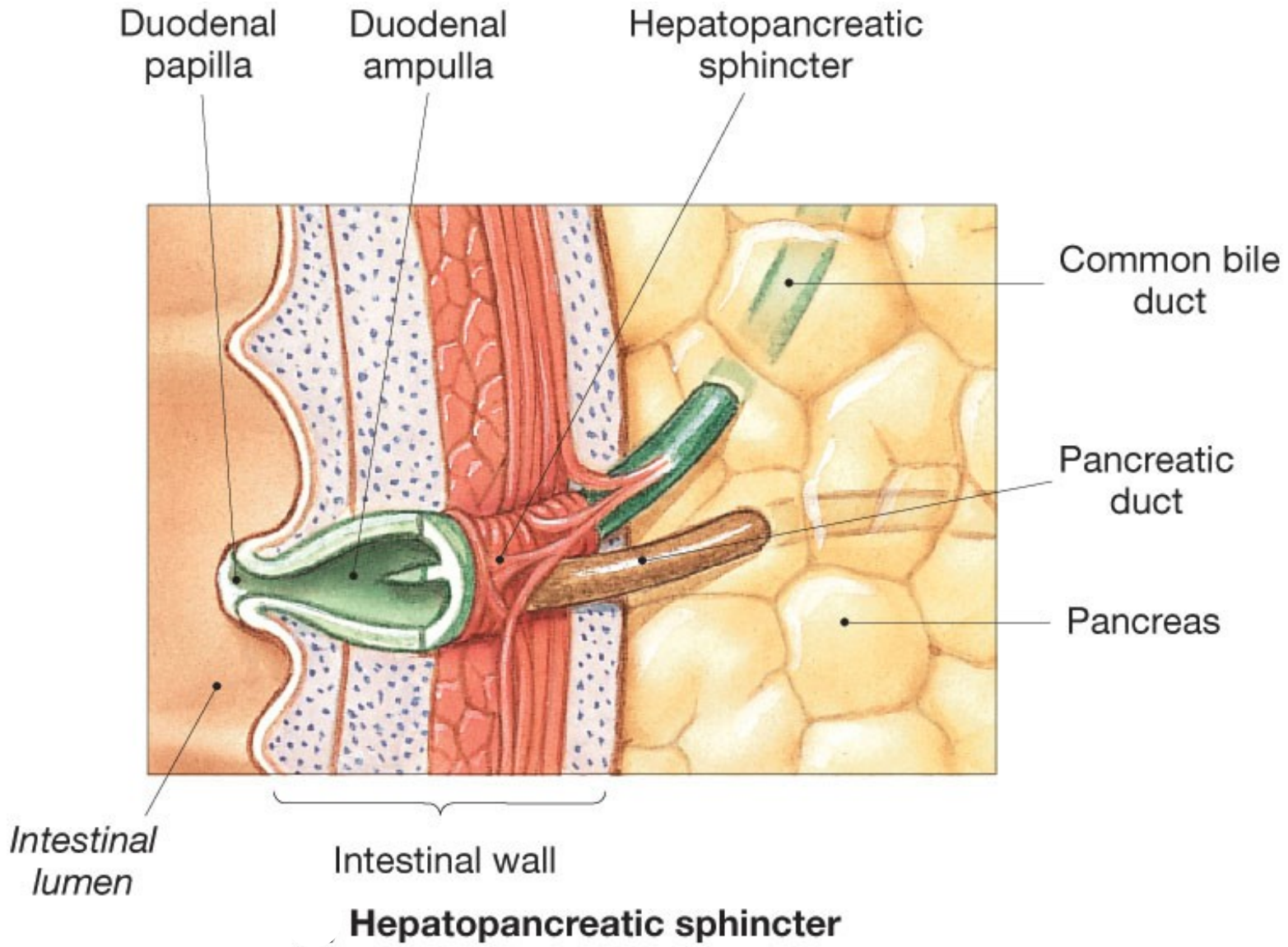
Diagrammatic view of **Liver** lobular organization.



Anatomy between the **Liver** (makes **Bile**), the **Gallbladder** (stores and concentrates bile), and the **Pancreas** (makes/releases pancreatic juices) into the **Duodenum**.



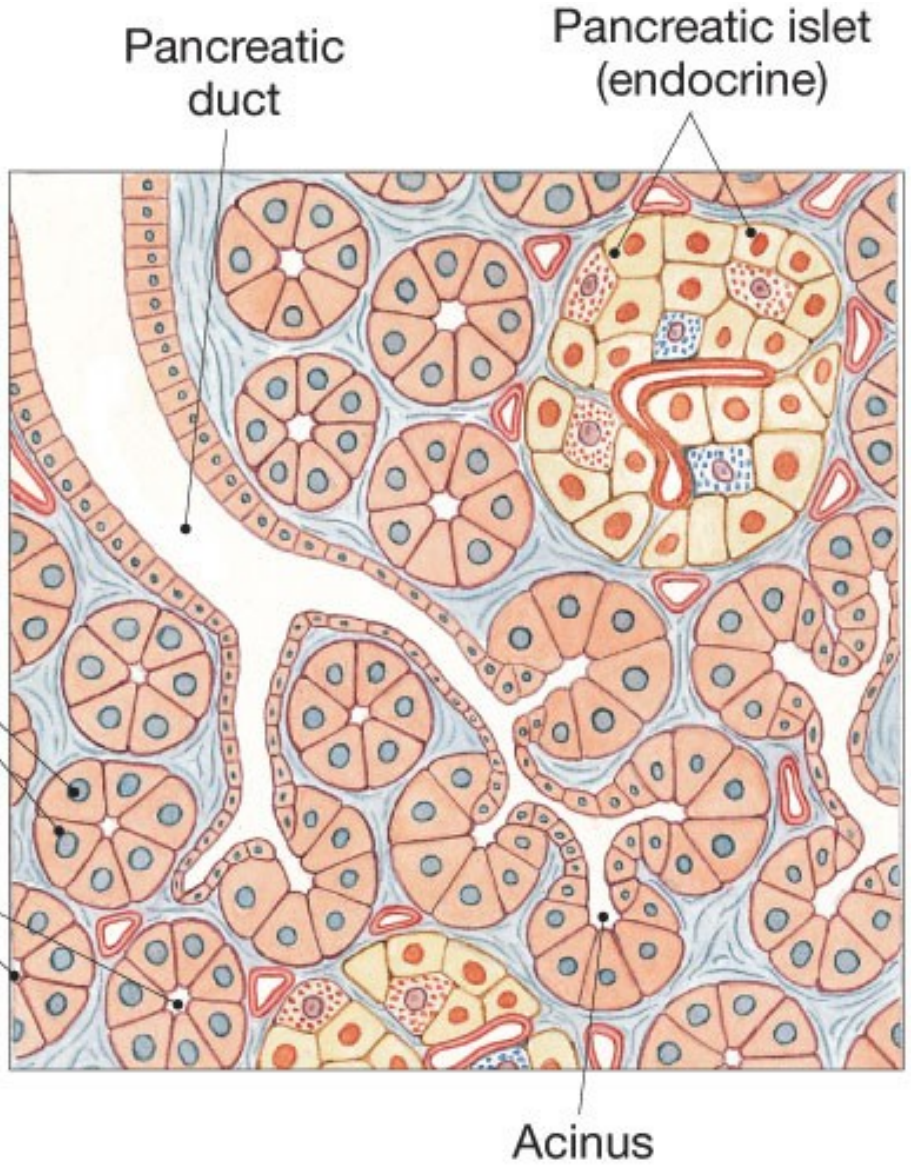
The roles of the Greater and Lesser Duodenal Papillae



Histology of the **Pancreas**

Exocrine Gland:
Pancreatic Juices

- *Amylases*
- *Proteases*
- *Lipases*

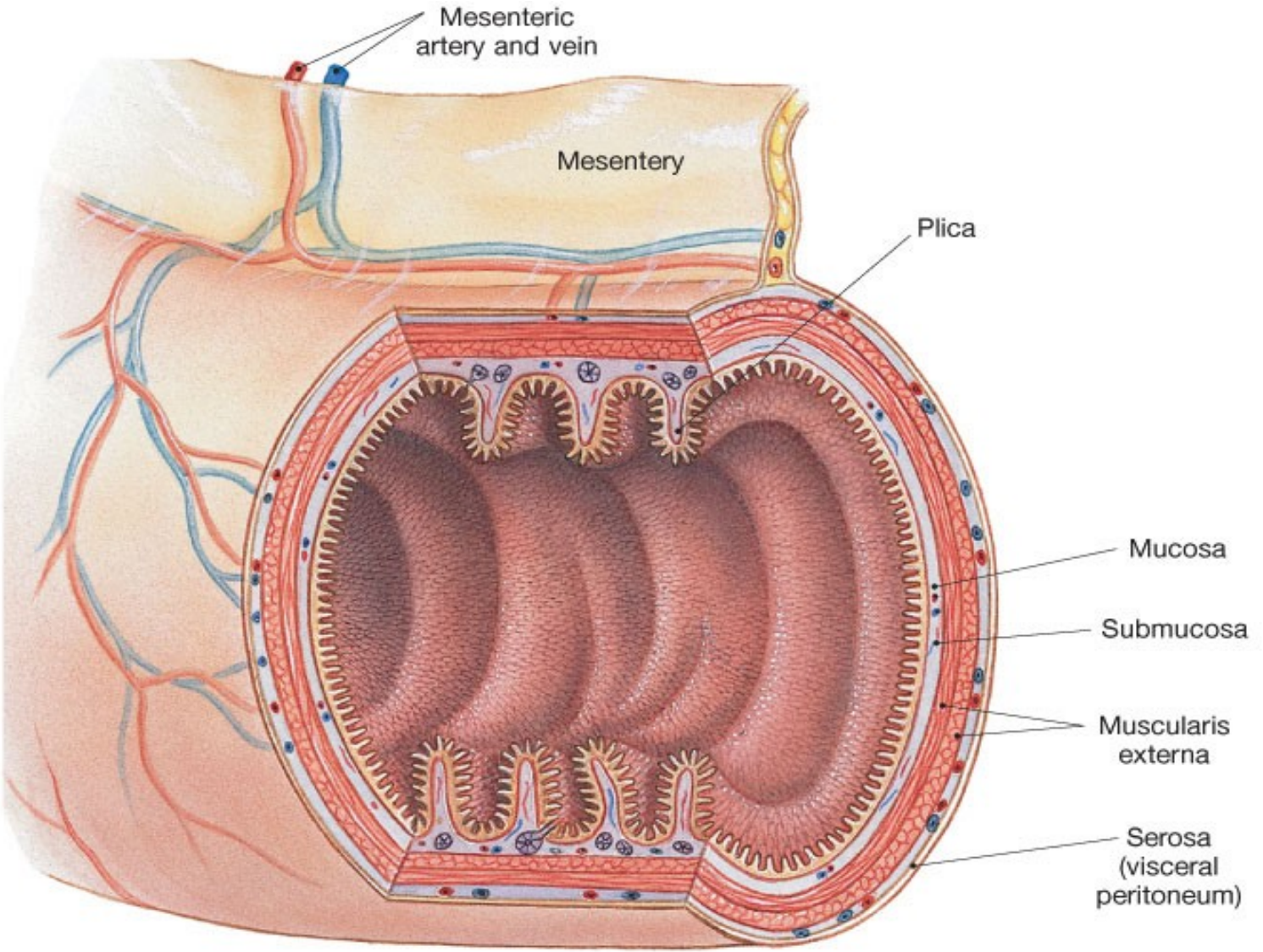


Pancreatic histology

Endocrine Gland:
Makes Hormones

- *Insulin*
- *Glucagon*
- *Somatostatin*
- *Gastrin*

Histology of the G.I. Tract



A Mucous Membrane

- Lines entire digestive tract
- Moistened by glandular secretions
- Simple or stratified depending on area of tract
- Pleated for expansion (↑Surface Area)

These are the **4** Layers!

1. Tunica Mucosa

is a Mucous Membrane (wet, absorbs, protects)

1) Epithelium
2) Lamina propria
3) Muscularis mucosae

2. Tela Submucosa

Areolar Connective Tissue

Contains:

Submucosal plexus (nervous innervation)

Blood and Lymphatic Vessels

3. Tunica Muscularis Externa

Smooth muscle layers

1) Inner Circular Layer
2) Outer Longitudinal Layer

What are some exceptions?

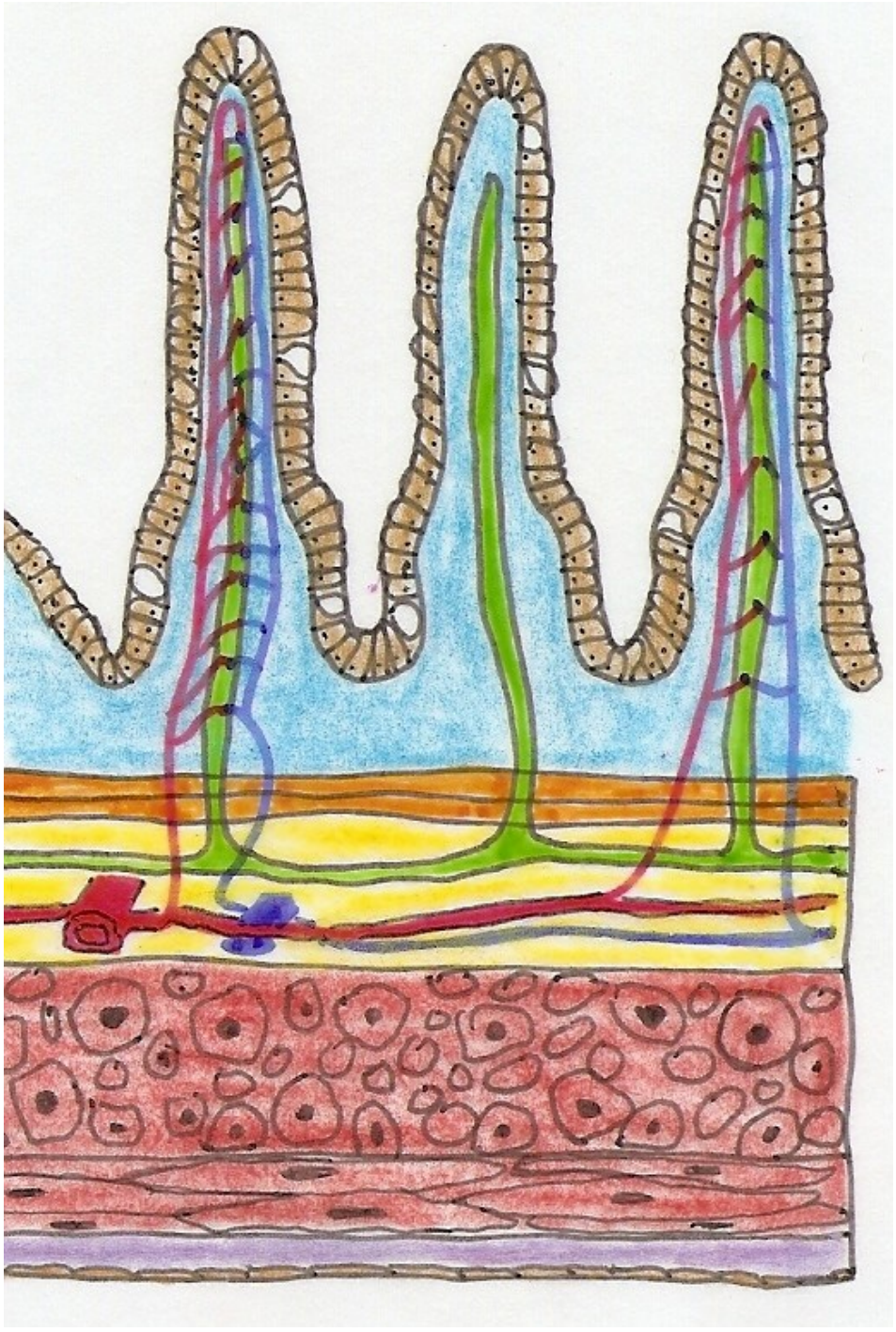
Myenteric Plexus

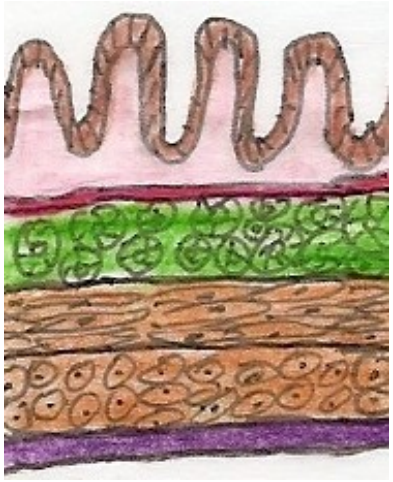
4. Tunica Serosa (or Adventitia*)

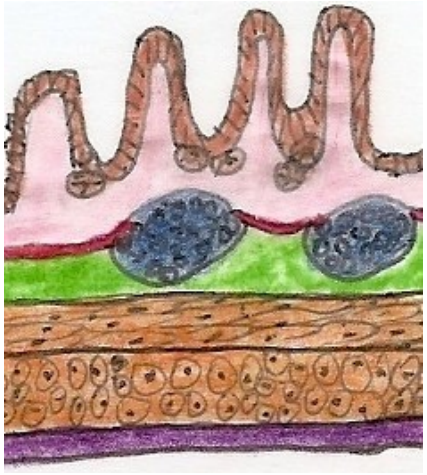
Serous membrane – aka visceral peritoneum

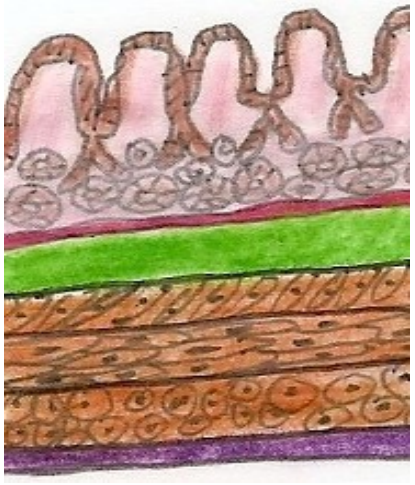
* Name depends on location:

a) Inside peritoneal cavity = serosa
b) Outside peritoneal cavity = adventitia









Layers: How are they different in each diagram above?

1. _____

2. _____

3. _____

4. _____

The Peritoneum: Two layers

Visceral peritoneum (a.k.a. serosa)

Parietal peritoneum - Lines inner surfaces of body wall

Mesenteries:

– Fused double sheets of peritoneal membrane to suspend portions of digestive tract:

e.g.

Greater omentum

Lesser omentum

Mesentery proper

Mesocolon

Retroperitoneal Structures – these are attached to posterior abdominal wall, and are not in the peritoneal cavity.

e.g.

- Most of the Duodenum
- Ascending colon
- Descending colon
- Pancreas

Horizontal section through the upper abdomen showing the position of the liver relative to other visceral organs.